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A novel in-situ soil enzymatic activity sensor- expanding soil precision measurements to indicator of soil health.

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Soil enzymes catalyse the hydrolysis of various soil compounds leading to an increase in the availability of nutrients for plants and microorganisms, but the increase in mobility might also lead to losses by leaching. Sources of extracellular soil enzymes in soil include release by soil microorganisms such as bacteria and fungi and plant roots but also microbial necromass. Irrespective of their source, the released enzymes can accumulate in the soil by becoming stabilized on mineral and organic surfaces. It is generally assumed that 40 to 60% of measured enzyme activity originate from stabilized enzymes. As such they directly affect the ability of a soil to fulfil its numerous functions, including the provision of nutrients to plants, the cleaning of percolating water and climate regulation.

Although measurements of soil enzyme activity are increasingly recognised as sensitive indicators of soil health, variations and inconsistencies between existing methods make it difficult to compare the results of different studies. Most commonly, soil enzyme activities are assessed using destructive biochemical laboratory incubations, thus altering the natural soil conditions.

Therefore, based on the principle of soil zymography, a membrane based method to map the heterogeneity of enzymatic activity on exposed soil surfaces, we developed a portative, hand-held sensor allowing rapid measurement of the soil enzymatic activity in-situ (Digit Soil; https://www.digit-soil.com/). In this presentation, we will compare the performance of our sensor to laboratory incubations for the application on various types of soils differing in basic properties such as pH, texture and soil organic matter content at different moisture conditions.

Based on the results, we will discuss the prospects this new sensor offers for rapid in-situ evaluation of soil health in the framework of precision agriculture and sustainability labels.